

REMARKS

Petition for Extension of Time Under 37 CFR 1.136(a)

It is hereby requested that the term to respond to the Examiner's Action of September 18, 2006 be extended three months, from December 18, 2006 to March 19, 2007 (March 18 being a Sunday).

Authorization to charge a Credit Card is given to cover the extension fee. The Commissioner is hereby authorized to charge any additional fees associated with this communication to Deposit Account No. 19-5425.

In the Office Action, the Examiner indicated that claims 1 through 34 are pending in the application and the Examiner rejected all claims.

The Specification

On page 2 of the Office Action, the Examiner required that the Title of the invention be amended. Applicant has amended the Title, in accordance with the Examiner's requirement.

Objections to the Claims

On page 2 of the Office Action, the Examiner made various objections to the claims. Applicant has amended the claims in accordance with the Examiner's suggestions and believes the claim objections have been overcome.

The §112 Rejections

On page 3 of the Office Action, the Examiner has rejected claims 11, 15, 23-26, and 31 under 35 U.S.C. §112, second paragraph, as being indefinite. Applicant has amended these claims and/or claims from which they depend to overcome these rejections. Applicant submits that by these amendments, claims 11, 15, 23-26 and 31 are now in compliance with 35 USC §112, second paragraph. Applicant therefore requests that this rejection be reconsidered and withdrawn.

Claim Rejections, 35 U.S.C. §§ 102 and 103

On page 4 of the Office Action, the Examiner rejected claims 1, 3-10, 12-14, 16-21, 23-28, 30-31, and 34 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 7,055,021 to Kadambi. On page 11 of the Office Action, the Examiner has rejected claims 1-2, 11-15, and 34 under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,289,442 to Asato.

On page 14 of the Office Action, the Examiner has rejected claim 22 under 35 U.S.C. §103(a) as being unpatentable over Kadambi in view of U.S. Patent No. 5,193,180 to Hastings, and has rejected claim 29 under 35 U.S.C. §103(a) as being unpatentable over Kadambi. On page 15 of the Office Action, the Examiner has rejected claims 32-33 under 35 U.S.C. §103(a) as being unpatentable over Kadambi in view of U.S. Patent No. 6,233,678 to Bala.

U.S. Patent No. 7,055,021 to Kadambi

Referring to paragraph 17(a) of the Office Action, Kadambi may appear relevant because of an unfortunate nomenclature collision. In Kadambi, the reference to a "strand" is to a sequence of independent threads of execution that execute asynchronously and thus do not have direct data dependencies. The discussion in Kadambi about scoreboards and replays is related to a sequence of instructions in a single strand/thread. The strands in the present application are however composed of instructions from the *same* instruction stream/thread and may therefore contain dependencies between them.

In order to further clarify this distinction and to more clearly distinguish applicant's invention from the prior art, applicant has amended claim 1 to read, in relevant part:

“(a) a sequence of operations from a single execution thread is divided into individual strands;”

Referring to paragraph 17 (b) of the Office Action, in Kadambi, threads are marked with identification numbers not for the purpose of time ordering, but simply for the purpose of labelling. These threads are independent instruction streams without inter-dependencies, so a time ordering to resolve dependencies is not required or anticipated.

In the present application, the strand number is performed statically (i.e., by the compiler at compile time) and represents the statically determined ordering of dependencies between strands. It is not simply the order that instructions are first issued, for instance an instruction from strand N + 1 may be issued before strand N.

Kadambi col. 11, line 16, indicates that the scoreboard state is independent for different strands/threads. Kadambi describes a dynamic mechanism to detect dependencies during execution and maintain this information transiently in the scoreboard. In contrast, the claims invention requires no hardware logic to dynamically detect and maintain this state information.

Referring to paragraph 17. (c) of the Office Action, the cited portion of Kadambi refers to the instructions from a single instruction stream (not from a strand as defined in the present application).

Referring to paragraph 17. (d) of the Office Action, in Kadambi the scoreboard mechanism detects dependencies between individual instructions. It does not hold the predication or mis-predication status for a group of instructions allocated to one of the strands as is claimed in the present application. Kadambi describes a mechanism to dynamically determine dependencies on a per instruction basis whereas the strand labelling approach of the present invention statically labels inter-dependent instructions at compile time to avoid the overhead of tracking them dynamically at run-time.

In order to further clarify the above-described distinctions and to more clearly distinguish applicant's invention from the prior art, applicant has amended claim 1 to read, in relevant part:

“(b) the strands are numbered at compile time to provide an implicit logical time ordering;”

U.S. Patent No. 6,289,442 to Asato

The Office Action rejects claims 1 - 2, 11 - 15 and 34 as anticipated by Asato (US Patent No. 6,289,442).

Asato describes a mechanism in a microprocessor whereby dynamic execution can follow both possible code paths following a conditional branch. This allows the processor to execute code from both paths and then invalidate operations from the path that turns out to be incorrect when the branch condition is eventually resolved. This avoids the latency normally associated with performing a branch. A tag is associated with instructions as they are executed, with a different tag on one branch from the other. This allows the appropriate instructions to be identified later to quash the ones from the wrong path. The tag format used can actually accommodate multiple levels of branches so that multiple paths can be speculated before the first is resolved. This analysis is performed dynamically as instructions are executed.

In the present invention, the strands are labelled statically at compile time. This avoids the hardware overhead with generating the tags dynamically. The instruction format in the present invention has bits within it that explicitly states which strand an instruction belongs to – i.e., they are explicitly labelled with strand numbers. Moreover, while Asato only discusses tagging for the purposes of branch speculation, the present invention allows the dependencies leading to the allocation of strand numbers to encompass other statically determinable potential data flow dependencies (e.g. via memory data speculation).

In order to further clarify this distinction and to more clearly distinguish applicant's invention from the prior art, applicant has amended claim 1 to read, in relevant part:

“(b) the strands are numbered at compile time to provide an implicit logical time ordering;

(c) the operations within each individual strand are explicitly labelled with strand numbering and are executed sequentially;”

Applicant submits that these amendments place independent claim 1 in condition for allowance and therefore requests that this claim, as amended, now be allowed.

Applicant submits that claims 2 - 34 each depend from, and include all the limitations of, a now allowable independent claim. In view of the above distinctions, applicant therefore requests that these claims, as amended, now be allowed.

The '103 Rejections

Applicant submits that none of the remaining references teach or suggest the claim elements discussed above, and therefore, the combining of references as suggested does not render the claims obvious.

Accordingly, applicant respectfully requests that the Examiner reconsider and withdraw the rejection of the claims under 35 U.S.C. '103.

Conclusion

In view of the foregoing amendments and remarks, applicant respectfully requests entry of the amendments, favorable reconsideration of the application, withdrawal of all rejections and objections and that claims 1 - 34 be allowed at an early date and the patent allowed to issue.

Included herein is a Petition for extension of time to respond to the Examiner's Action, and authorization to charge the extension fee to a credit card. The Commissioner is hereby authorized to charge any additional fees or credit any overpayment associated with this communication to Deposit Account No. 19-5425.

Respectfully submitted

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Date

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